# A PROGRESS REPORT OF SOME IRRIGATION MANAGEMENT RESEARCH IN CENTRAL AND EASTERN OREGON[1]

Information I will present is more or less of a progress report of some of our irrigation management research, particularly apertaining to surface or gravity type irrigation. Some of this information which will be presented is necessarily quite tentative, and further research will be necessary before the true accuracy of some of this data can be determined.

However, we believe that this sort of presentation is a good way to keep you as currently informed of the work we are doing and thus, we are presenting all our data on these phases, and it may have to be changed later as further research reveals more accurate results.

Irrigation has been practiced since man first diverted water from the Nile River to improve his crops, and until relatively very recently water was applied almost wholly by gravity or surface methods.

Isn't it reasonable to assume, that from the vast amount of irrigation information collected, that certain basic principles can be developed which should aid an irrigator regardless of this method of irrigation?

Basic irrigation principles have been developed which apertain to all methods of irrigation and should prove useful to the sprinkler irrigator and designer as well.

On this premise I plan to present some of our irrigation information largely secured from surface or gravity type irrigation studies in central and eastern Oregon.

This will be presented in three sections as follows:

1. Consumptive use and peak use of crops studied.
2. Irrigation efficiencies.
3. Effect of crop on intake capacity of the soil.



The first section concerns itself with consumptive use and peak or maximum use requirement of crops.

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1/ Prepared by Fred M. Tileston, Irrigation Engineer, U.S.D.A., Agriculture Research Service, Soil and Water Conservation Branch, Irrigation and Drainage Investigations, and Oregon Agricultural College, Presented at Oregon State College Irrigation Clinic, March 23, 1954.

It is generally true that any crop on a certain site regardless of the method of irrigation and if supplied with adequate moisture will use approximately the same amount of water at about the same rate. Thus these facts we will discuss under the first section will apply equally well to all methods of irrigation in these particular sites or areas.

<u>Consumptive use</u> by definition is the total seasonal amount of water used by the plant and evaporated from the adjacent soil surface.

The consumptive use plus a reasonable amount of water for allowable waste is the <u>total irrigation requirement</u> of the crop. The total irrigation requirement is thus largely controlled or is influenced by the <u>efficiency of irrigation</u>. This influencing factor will be discussed later.

We have in our studies measured the consumptive use of several crops grown in central and far eastern Oregon and average results are presented in Table 1. These data indicate that consumptive use is different for different crops.

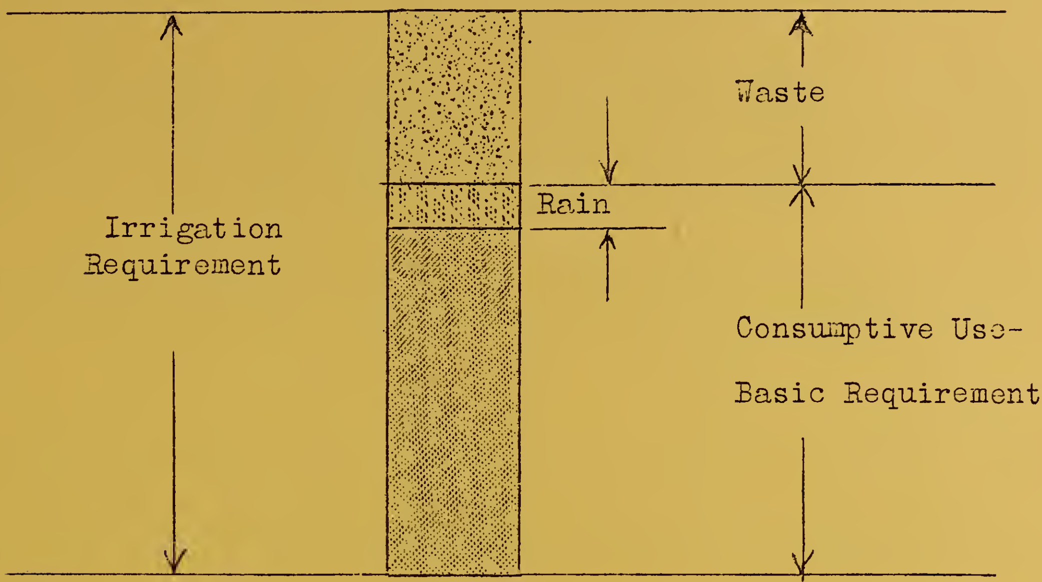
Table 1.-Seasonal Consumptive Use Requirements of Certain Crops of Central and Eastern Oregon (Rainfall Included During Growing Season)

| Crop | Consumptive Use Plus Rainfall | |
|---|---|---|
| | Madras Area | Ontario Area |
| | Inches | Inches |
| Wheat | 14.5 | 25.6 |
| Barley | | 18.0 |
| Alfalfa | 24.3 | 37.7 |
| Alsike Clover | 23.2 | |
| Ladino Clover | 24.2 | |
| Kenland Clover | 20.2 | |
| Red Clover | | 31.4 |
| Pasture | 28.2 | 34.7 |
| Potatoes | 18.6 | |
| Corn | | 23.2 |

I want to caution you against a literal interpretation or use of these data. These figures represent the basic requirements of the plants. This is the amount of water we measured which will be needed to supply the crop if there were no rainfall or other source of water.

We will necessarily have to supply an additional amount over this basic need to provide for reasonable waste as shown in this graphical figure showing the disposal of water used on perhaps any farm field.

Figure 1.-Disposal of Irrigation Water on a Typical Farm Field.

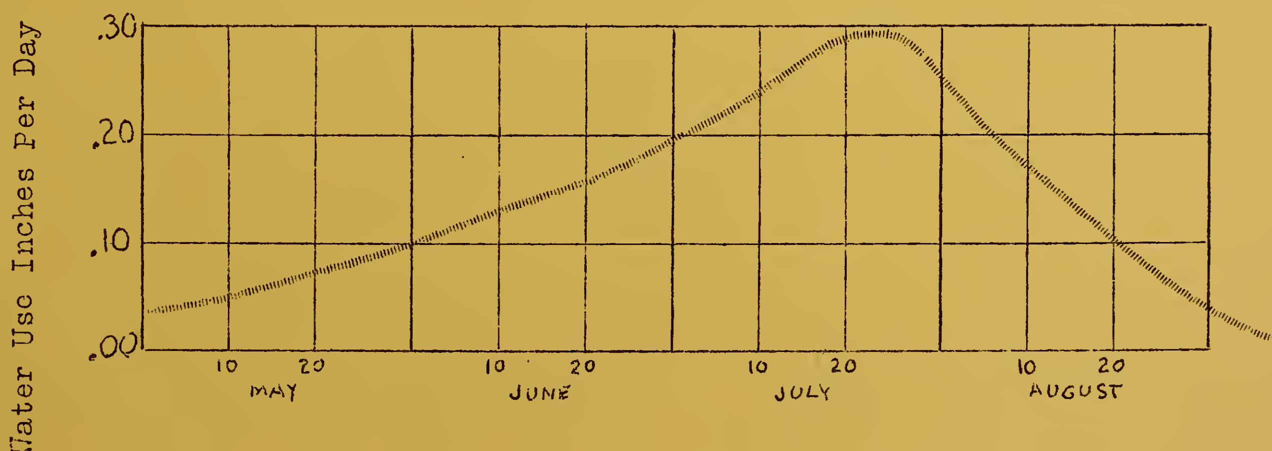



In addition to the consumptive use data we also secured the rate of use for the same crops as listed previously and these data are presented as curves showing how the water use rate changes during the growing season. These curves are presented in the Appendix.

The inches depth of water consumptively used in 24 hours is known as the rate of use or water use in inches per day. We need to know this average peak rate of use in order to provide an adequately designed irrigation system.

A graph of the rate of use as presented in this simple illustration shows that it usually increases as the season progresses. Generally reaching some maximum peak as shown and then declining to harvest or the end of the growing season.

Figure 2.-Rate of Use Curve in Inches Per Day.



This curve which is typical of all our crop data is presented to emphasize that the rate of water use does change markedly during the season.

It is also important that this peak rate of use occurs at different times during the growing season depending on the location, climate and crop grown. However, this peak use rate will generally occur sometime during July or the first part of August.

A good sprinkler irrigation system designer must be aware and know these facts to do a good job. I am sure most of you are aware of this change of water use rate and probably design your system accordingly.

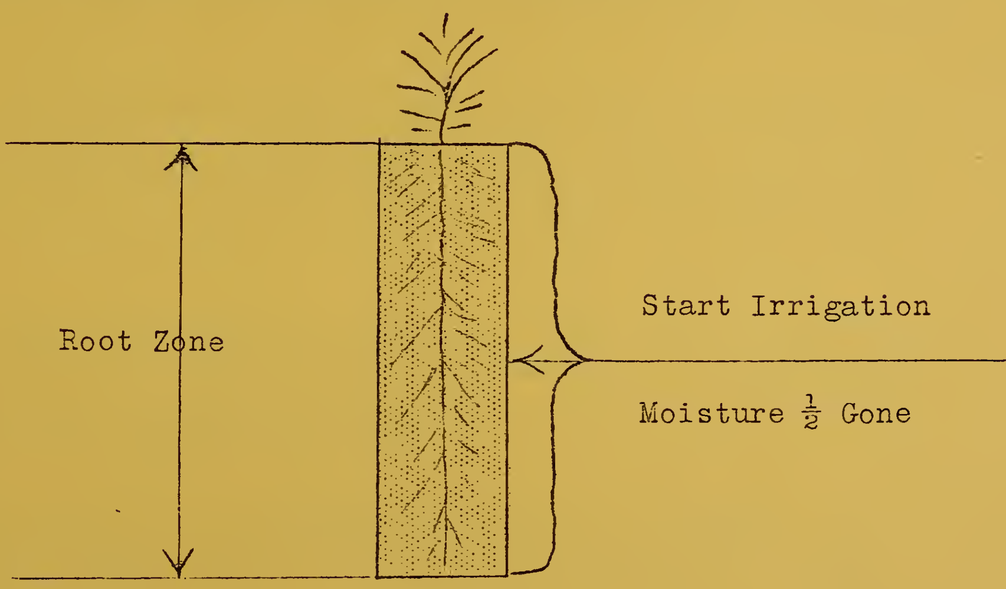
In addition to the previous basic data, we secured the available moisture holding capacities of the soils on which we are working. The soil is our water reservoir, and the total water, plants may remove from this reservoir is known as the totally readily available moisture which is presented in Appendix Tables at the end of this write-up.

The data from these tables show that the readily available moisture also varies for different kinds of soil.

This information is also important to our irrigation system designs and operation. We need to know the required amount of water to fill this reservoir to irrigate correctly.

This simple illustration shows that we should irrigate when approximately one half of the readily available moisture in the root zone has been depleted.

Figure 3.-Moisture Depletion Illustration.




In other words we need to add one half of the readily available water to fill our soil moisture reservoir.

The root zone of the plant as well as the storage capacity of the soil varies, and is different for different crops and soils. The irrigation planner should be aware and cognizant of these facts to do a good job.

This leads us to the second section of this presentation which concerns itself with irrigation efficiency.

Irrigation efficiency is by definition the ratio in percent of the needed moisture to that applied. You will recall from our previous discussion if we add more water than this amount needed to fill the soil reservoir, as shown in this illustration, our irrigation efficiency is reduced.

If water runs off the end of the field, our irrigation efficiency also goes down. As you can see, increasing water waste would decrease irrigation efficiency. If the soil reservoir were just filled, and no waste occured, we would have a good irrigation efficiency indeed.

The irrigation efficiencies vary greatly, and I will discuss briefly variations of the irrigation efficiency with particular reference to gravity or surface type of irrigation. We found in our studies of gravity irrigation system that irrigation efficiencies can go as high as 94% and as low as 15% for different kinds of irrigation under different kinds of crops. These variations may occur at any time during the season and during any irrigation.

Generally, under gravity irrigation, higher irrigation efficiencies are achieved when the irrigation system has been properly designed for the site and the irrigator understands correctly how to use it. This same criteria, of course, could apply to sprinkler type of irrigation as well.

We find that low irrigation efficiencies occur where through lack of knowledge of the amount of water needed to fill the soil, the irrigation or length of "sets" are needlessly prolonged. This results in excessive water wastage by deep percolation and runoff the end of the field.

The method or type of irrigation system may also effect irrigation efficiency. Good irrigation efficiency can be achieved if the method of irrigation whether it be sprinkler or gravity is properly selected, designed and operated for the site and crop.

We compared the border and corrugation method of irrigation in central Oregon and found the average of irrigation efficiencies for border strip method was 94%. This is a very high efficiency, indica-

ting low water waste. Irrigation efficiency for the corrugation method of irrigation under the same site conditions and crop was 73%. This indicates that for this site and crop studied, the border strip irrigation method is probably the best type of irrigation system.

We also compared the field irrigation efficiency with the farm irrigation efficiency in central Oregon, and found that field irrigation efficiency may vary greatly, for different fields and have little relation to the overall farm irrigation efficiency. This comparison may be changed depending upon whether or not the runoff waste from one field may be reused on a lower lying field.

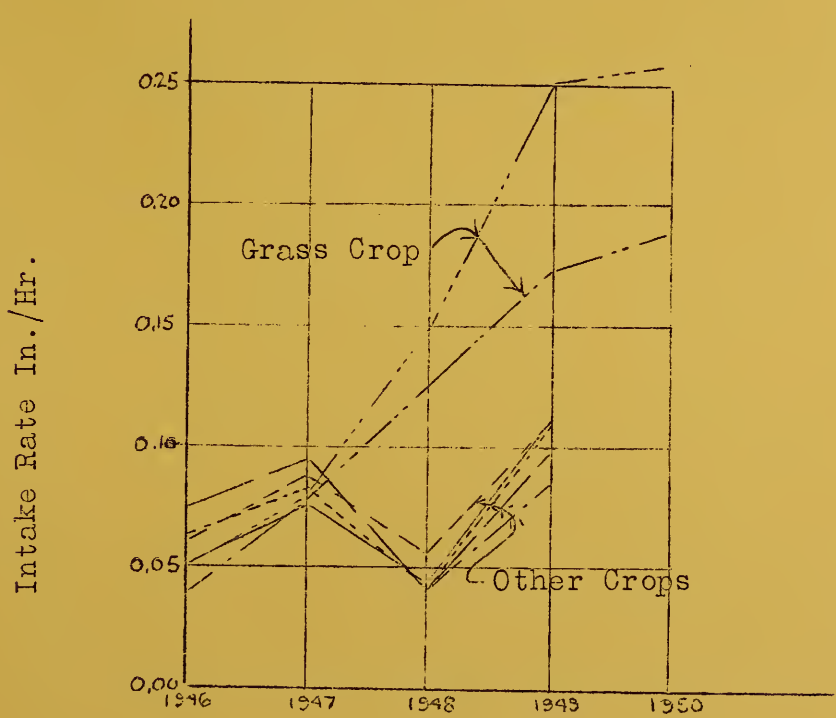
If runoff waste can be reused the farm irrigation efficiency can be increased, but of course if the runoff waste from the field cannot be reused, then the overall farm efficiency is reduced from that which might be achieved if waste water from one field could be reused on a lower lying field within that same field.

The efficiency of irrigation may also be affected by other factors, among them is the intake capacity of the soil which in our outline at the start of this talk is the last section.

Our studies in eastern Oregon during the last five years on soils where intake capacity is relatively low have indicated that the crop has a very marked effect on the intake capacity of the soil.

This illustration shows an example under corrugation irrigation of the effect of growing grass on the intake rate.

Figure 4.-Changes of intake rates for different crops by years.1/
(Ontario, Oregon, Area Studies)




1/ Taken from Oregon Agricultural College Tech. Bul. No. 23, March 1952.

The lower graph represents other crops grown such as corn. grain and other crops and the two upper graphs are the intake rates of the soil under grass.

It will be noted that the intake capacity has increased several fold where grass has been grown on this type of soil over a period of years.

Other experiments on the farm fields have indicated that alfalfa on these particular types of soils also increase the intake capacity of the soil many fold. We have secured results from our farm field studies that indicate alfalfa increases the intake characteristics, while a row crop such as corn result in the reverse effect. We are not sure however, whether or not this may be largely due to a mechanical affect rather than any change in the basic soil intake capacity itself.

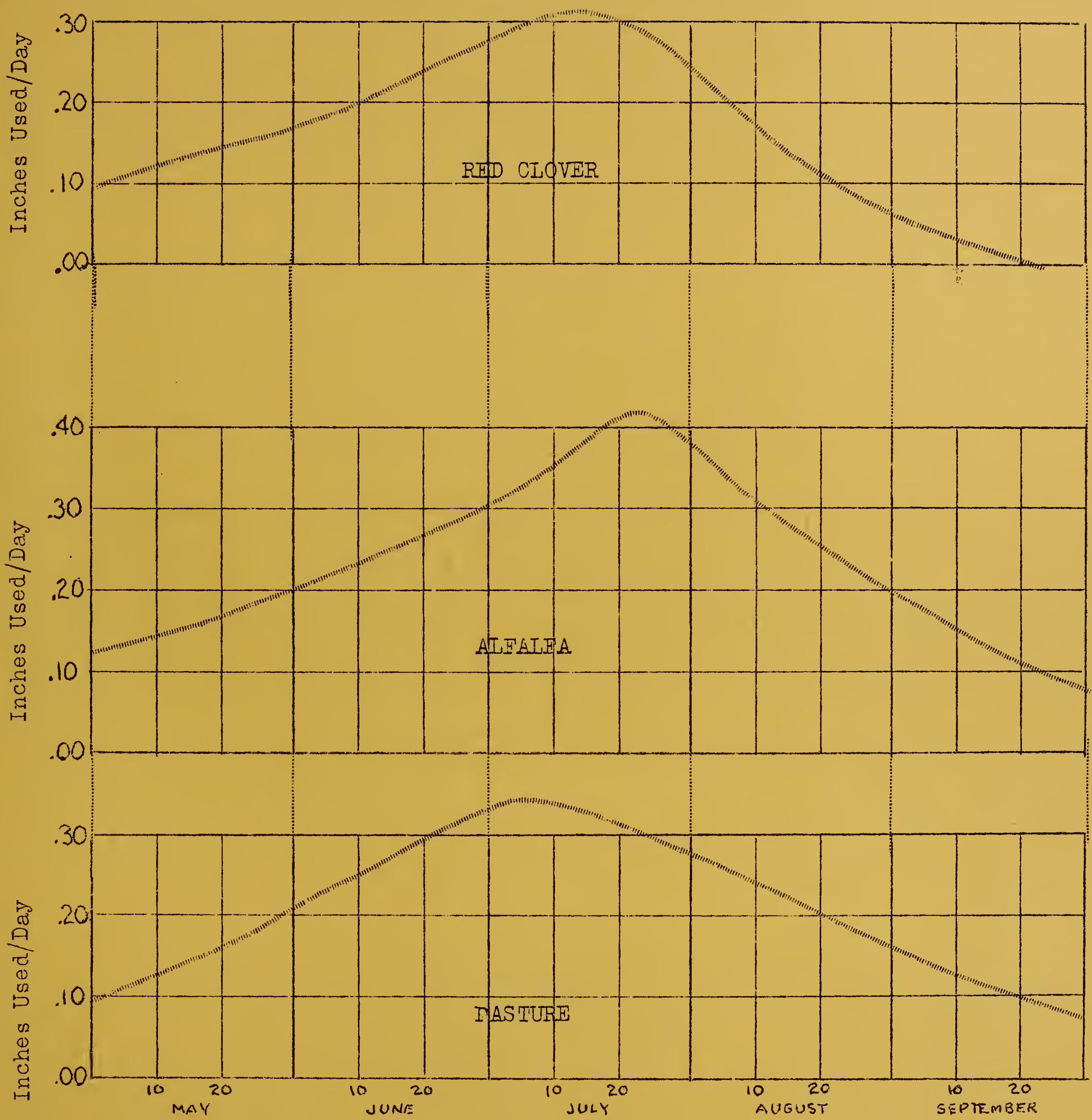
We are, however, of the general opinion, particularly where gravity or surface irrigation is used, that the crop will have some effect upon the intake capacity of the soil. We believe that a forage type crop such as pasture, alfalfa, and or other close-growing type of crops should be beneficial and help to increase the intake capacity of the soil, thus making irrigation management much easier on these relatively low intake capacity soils.

Appendix Table 1.-Readily Available Moisture Capacity of Some Soils of the Ontario, Oregon, Area.

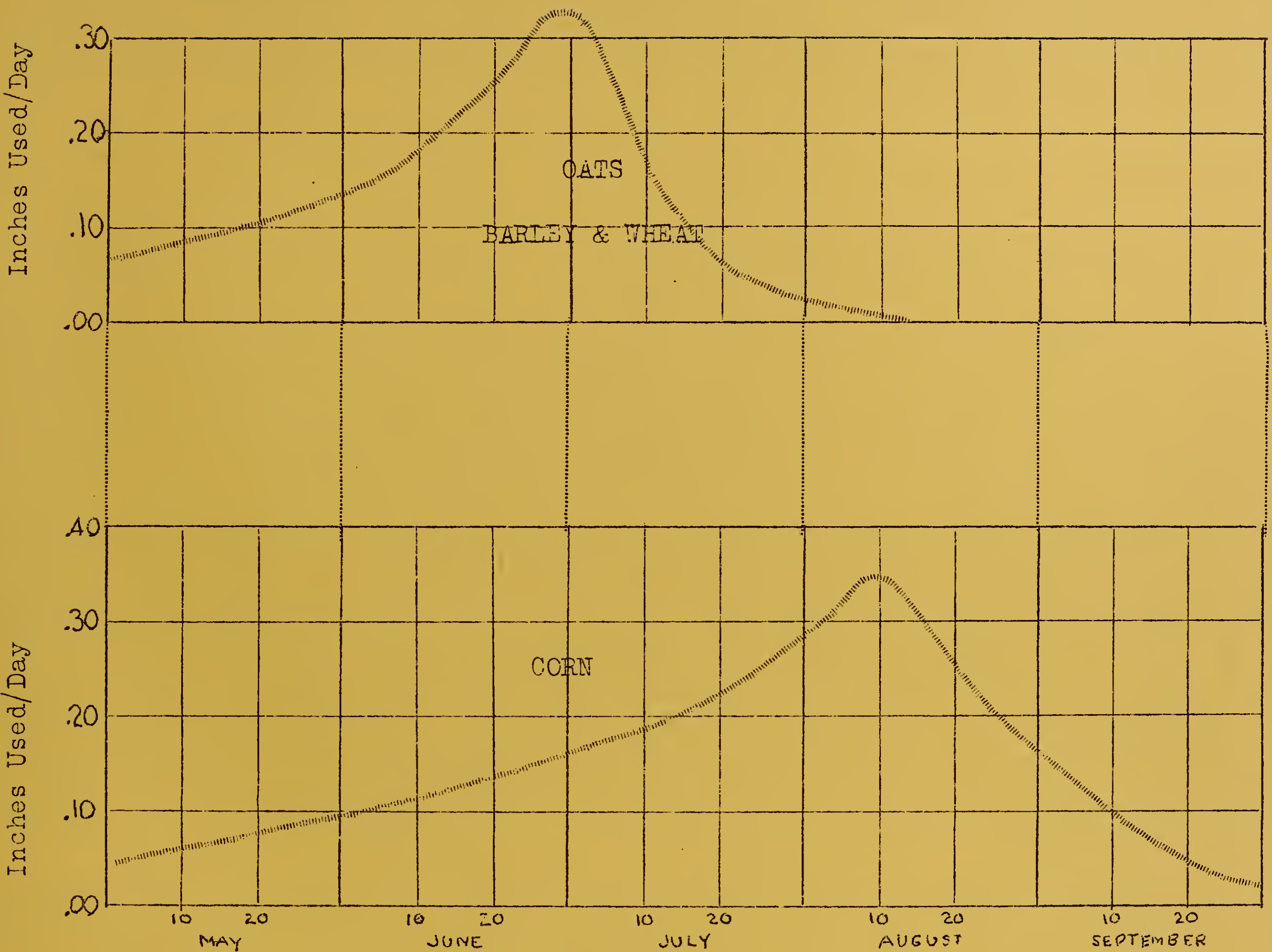
| Soil Type | Average per foot of depth | |
|---|---|---|
| | First & Second Foot | Third & Fourth Foot |
| | Inches | Inches |
| 20 group soil (U.S.B.R. classification) | 1.8 to 2.8 | 1.8 to 3.2 |
| 110 group soil (U.S.B.R. classification) | 1.7 to 3.0 | 2.3 to 3.3 |

Appendix Table 2.-Readily Available Moisture Capacity of Soils of the Madras, Oregon, Area.

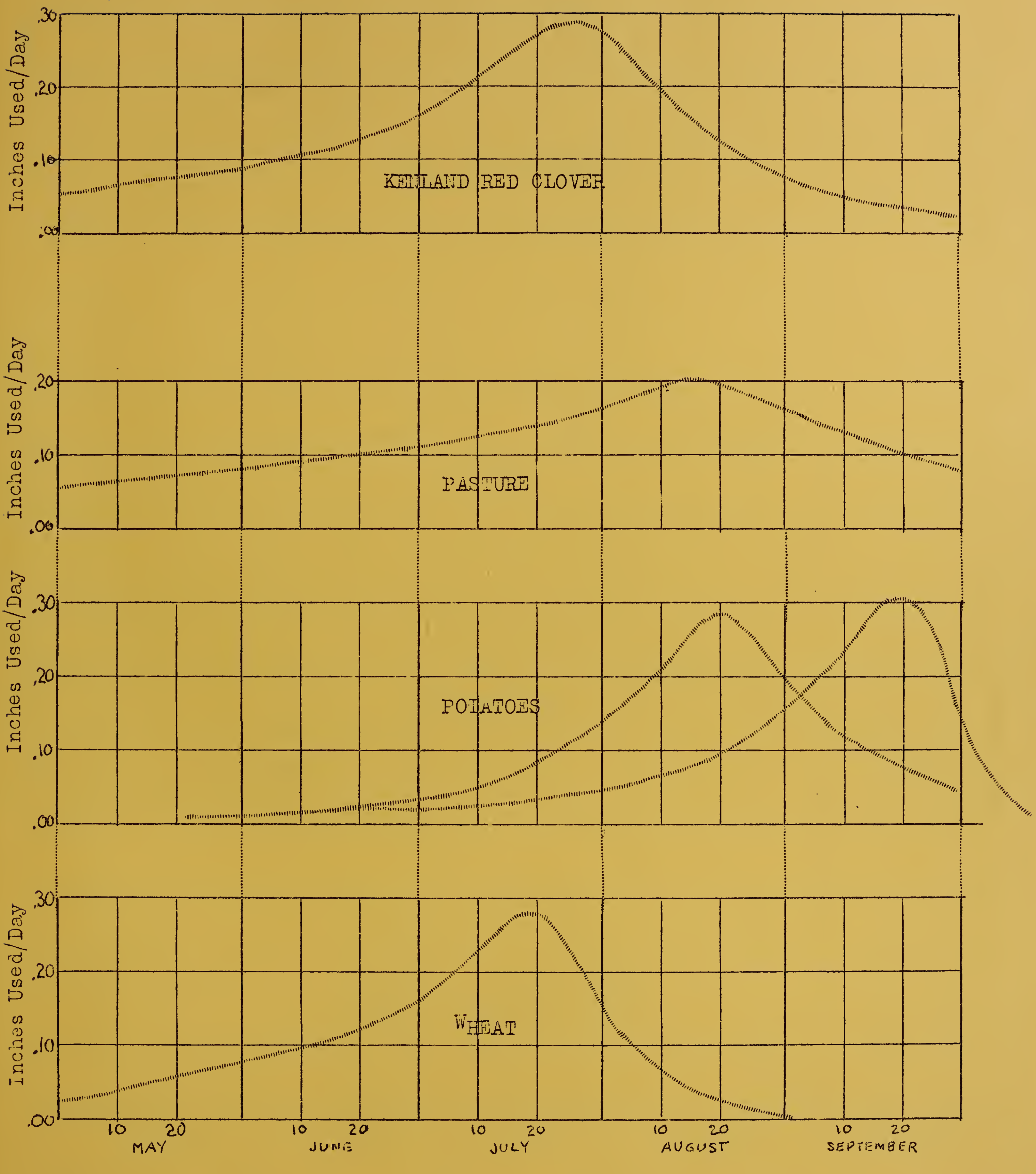
| Soil Type | Average per foot of depth | |
|---|---|---|
| | First & Second Foot | Third & Fourth Foot |
| | Inches | Inches |
| Madras Loam | 1.2 to 2.2 | |
| Agency Loam | 1.6 to 2.4 | |
| Lamonta Loam | 1.1 to 2.2 | |
| Deschutes Loamy Sand | 1.3 to 1.6 | |
| Madras Sandy Loam | 1.5 to 2.3 | |
| Agency Sandy Loam | 1.4 to 2.3 | |
| Deschutes Sandy Loam | 1.4 to 2.4 | |
| Redmond Sandy Loam | 1.7 to 2.5 | |
| Deschutes Coarse Sandy Loam | 1.2 to 1.3 | |
| Agency Gravely Loam | 1.8 to 2.2 | |



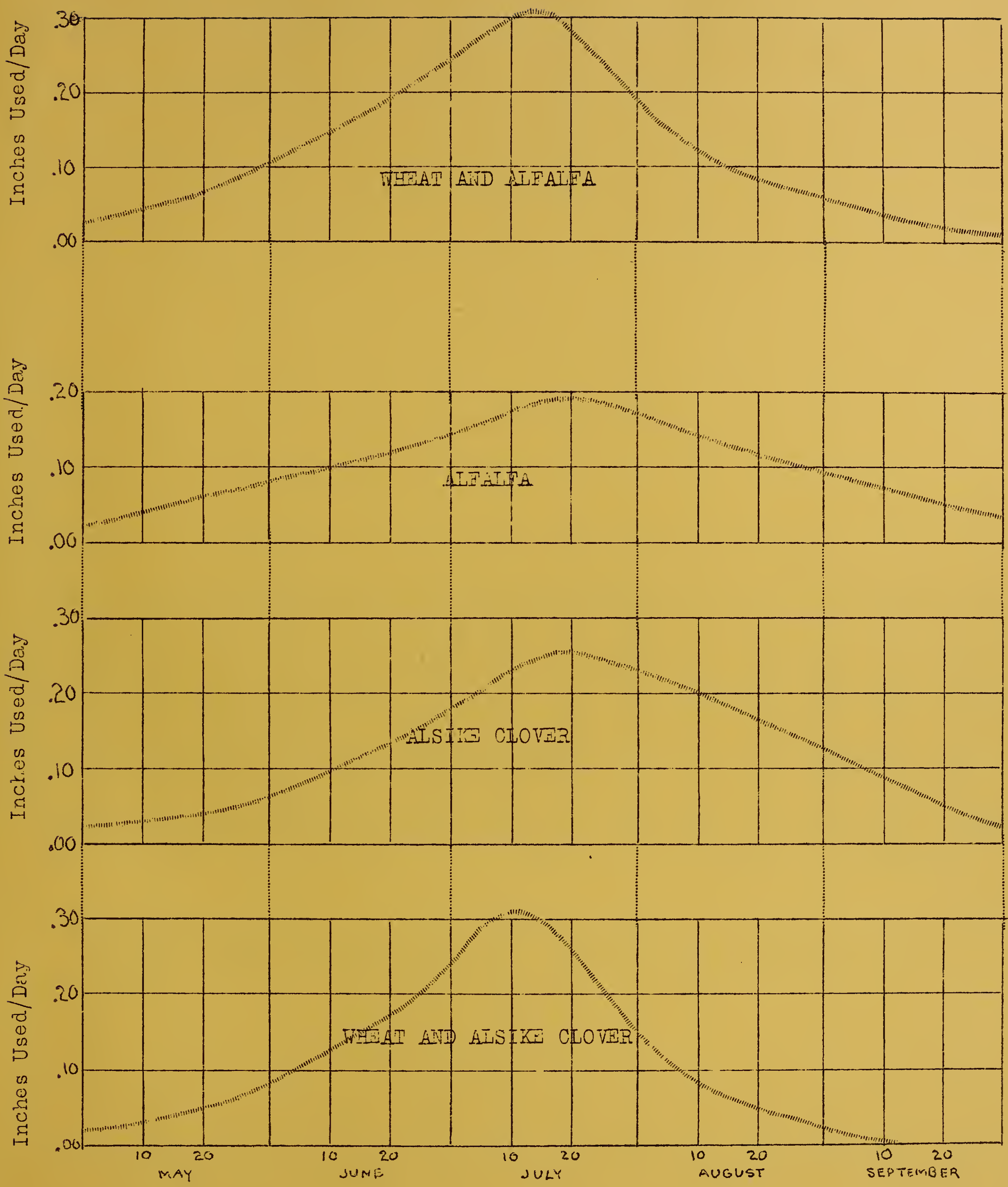

Appendix Figure 1.-Rate of Water Use for Different Crops, Ontario, Oregon, Irrigation Studies, 1950, 51, 52 and 53 inclusive



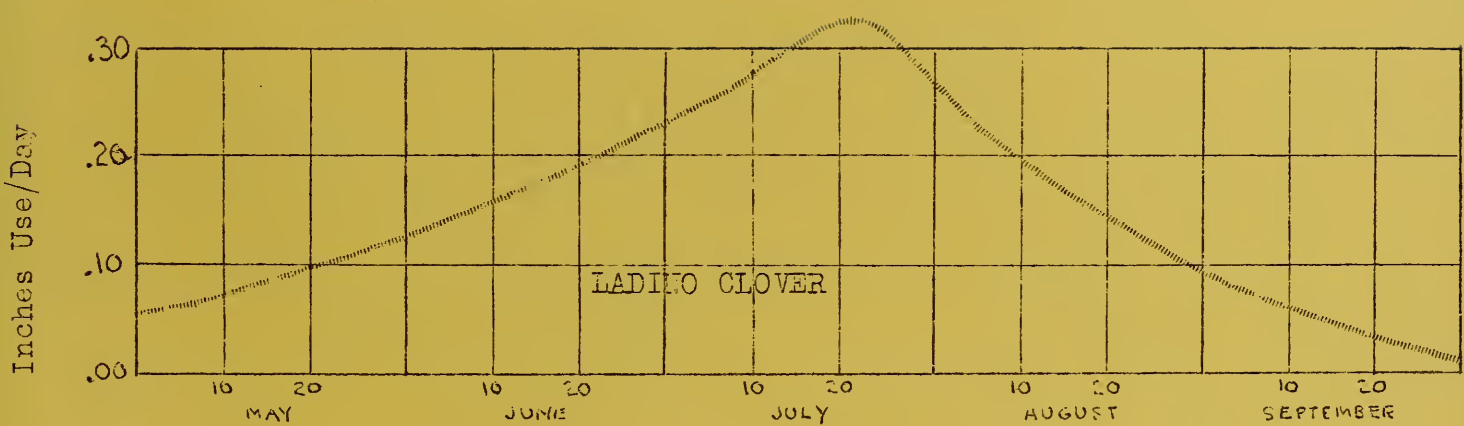

Appendix Figure 1.-(continued) Rate of Water Use for Different Crops, Ontario, Oregon Area Studies, 1950, 51, 52 and 53 inclusive




Appendix Figure 2.-Rate of Water Use for Different Crops, Madras, Oregon Irrigation Studies, 1951, 52 and 53 inclusive




Appendix Figure 2.(continued).-Rate of Water Used for Different Crops, Madras, Oregon, Irrigation Studies, 1951, 52 and 53 inclusive




Appendix Figure 2 (continued).-Rate of Water Use for Different Crops, Madras, Oregon, Irrigation Studies, 1951, 52 and 53 inclusive.